ZooKeys

ZooKeys 1217: 101–117 (2024)
DOI: 10.3897/zookeys.1217.134704

Research Article

150 years after Ferdinand Morawitz: a survey of megachilid bees (Hymenoptera, Megachilidae) of Dagestan, Russia

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Abstract

A list of 148 species of megachilid bees from 16 genera and five tribes is reported for the Republic of Dagestan. The list is based on more than 2,500 examined specimens and one reliable literature record. Twelve species are new to Russia: *Chelostoma* (*Chelostoma*) *emarginatum* (Nylander, 1856), *C.* (*Foveosmia*) *maidli* (Benoist, 1935), *Hoplitis* (*Alcidamea*) *campanularis* (Morawitz, 1877), *H.* (*A.*) *caucasica* (Friese, 1920), *H.* (*Anthocopa*) *perezi* (Ferton, 1894), *H.* (*Pentadentosmia*) *tringa* (Warncke, 1991), *Osmia* (*Allosmia*) *melanura* Morawitz, 1871, *O.* (*Helicosmia*) *breviata* Warncke, 1988, *O.* (*Osmia*) *scheherazade* Peters, 1978, *O.* (*Pyrosmia*) *saxicola* Ducke, 1899, *Anthidium* (*Anthidium*) *taeniatum* Latreille, 1809, and *Megachile* (*Chalicodoma*) *montenegrensis* Dours, 1873. Nine other species are new to the North Caucasus, and 46 other species are new to Dagestan. Compared to the first list of the bees of Dagestan published by F. Morawitz 150 years ago, the number of species of Megachilidae known from the republic was increased by five times.

Key words: Biodiversity, Caucasus, new record, Palaearctic region

Academic editor: Michael S. Engel
Received: 14 August 2024
Accepted: 11 October 2024
Published: 30 October 2024

ZooBank: https://zoobank.org/4B5A1491-13C2-4EA8-BFFE-646211FAFCD1

Citation: Fateryga AV, Proshchalykin MYu (2024) 150 years after Ferdinand Morawitz: a survey of megachilid bees (Hymenoptera, Megachilidae) of Dagestan, Russia. ZooKeys 1217: 101–117. https://doi.org/10.3897/zookeys.1217.134704

Introduction

The Republic of Dagestan is the most southern region of Russia. The northern half of Dagestan is a part of the Caspian Depression while its southern half is a part of the Greater Caucasus, one of the most important biodiversity hotspots in the world. The area of Dagestan is somewhat more than 50,000 km^2, which is not particularly large but the territory of the republic is elevated from −27 to 4,466 m a.s.l. Therefore, landscapes and habitats are extremely diverse and correspondingly changing from lowland deserts to alpine meadows, with a few forest zones as well. The biodiversity of the Republic of Dagestan is also very high; there are more than 3,500 species of vascular plants and 604 species of vertebrates occurring here, while invertebrates are generally poorly studied (Red Book of the Republic of Dagestan 2020). The Megachilidae is a large family of bees numbering more than 4,000 described species worldwide (Michener 2007; Ascher and Pickering 2024); 220 species are known from Russia (Proshchalykin et al. 2023), while knowledge of megachilid bees of Dagestan is very incomplete.

Ferdinand Morawitz (1827–1896) was one of the leading specialists on the bees (Hymenoptera, Anthophila) at the end of the 19th century (Fig. 1A). He published 64 papers, 44 of them dealing with melittology. In total, Morawitz described five new genera and 725 new species of bees, including 185 species of the family Megachilidae (Pesenko and Astafurova 2003). The vast majority of the species described by him are currently recognized as valid (Schwarz 1980a, 1980b, 1987; Schwarz and Gusenleitner 2002, 2004; Dathe and Proshchalykin 2017; Astafurova and Proshchalykin 2020; Astafurova et al. 2021, 2022). In 1873, Morawitz published the first paper dealing with the bees of Dagestan (Fig. 1B), where he reported 30 species of the family Megachilidae (Morawitz 1873). Six of these species were described as new to science, of which four are currently recognized as valid species (Table 1, Fig. 1C, D). Considering some recently published papers (Fateryga 2017; Fateryga et al. 2019, 2023; Fateryga and Proshchalykin 2020; Litman et al. 2021; Levchenko 2023; Proshchalykin et al. 2023), the number of species of megachilid bees of Dagestan has been increased to 81, which is expected to be still very far from the true number of species occurring in the republic. The purpose of the present contribution is to publish the complete list of all species of megachilid bees known from the Republic of Dagestan to date.

Table 1. Species of the family Megachilidae described from Dagestan by Ferdinand Morawitz.

Species name	Sex	Type locality	Current status	Source
Anthidium alpinum Morawitz, 1873	♂	Kurush	Valid, as *Pseudoanthidium alpinum* (Morawitz, 1873)	Kasparek 2022; Kasparek and Ebmer 2023
Anthidium clypeare Morawitz, 1873	♀	Derbent	Valid, as *Eoanthidium clypeare* (Morawitz, 1873)	Kasparek 2020, 2022
Coelioxys conspersa Morawitz, 1873	♀	Derbent	Junior synonym of *Coelioxys polycentris* Förster, 1853	Schwarz and Gusenleitner 2003; Fateryga et al. 2019
Coelioxys pulchella Morawitz, 1873	♂	Derbent	Junior synonym of *Coelioxys haemorrhoa* Förster, 1853	Schwarz 2001; Schwarz and Gusenleitner 2003
Osmia nana Morawitz, 1873	♂	Derbent	Valid	van der Zanden 1991; Warncke 1992
Osmia viridana Morawitz, 1873	♀, ♂	Derbent	Valid	van der Zanden 1991; Warncke 1992

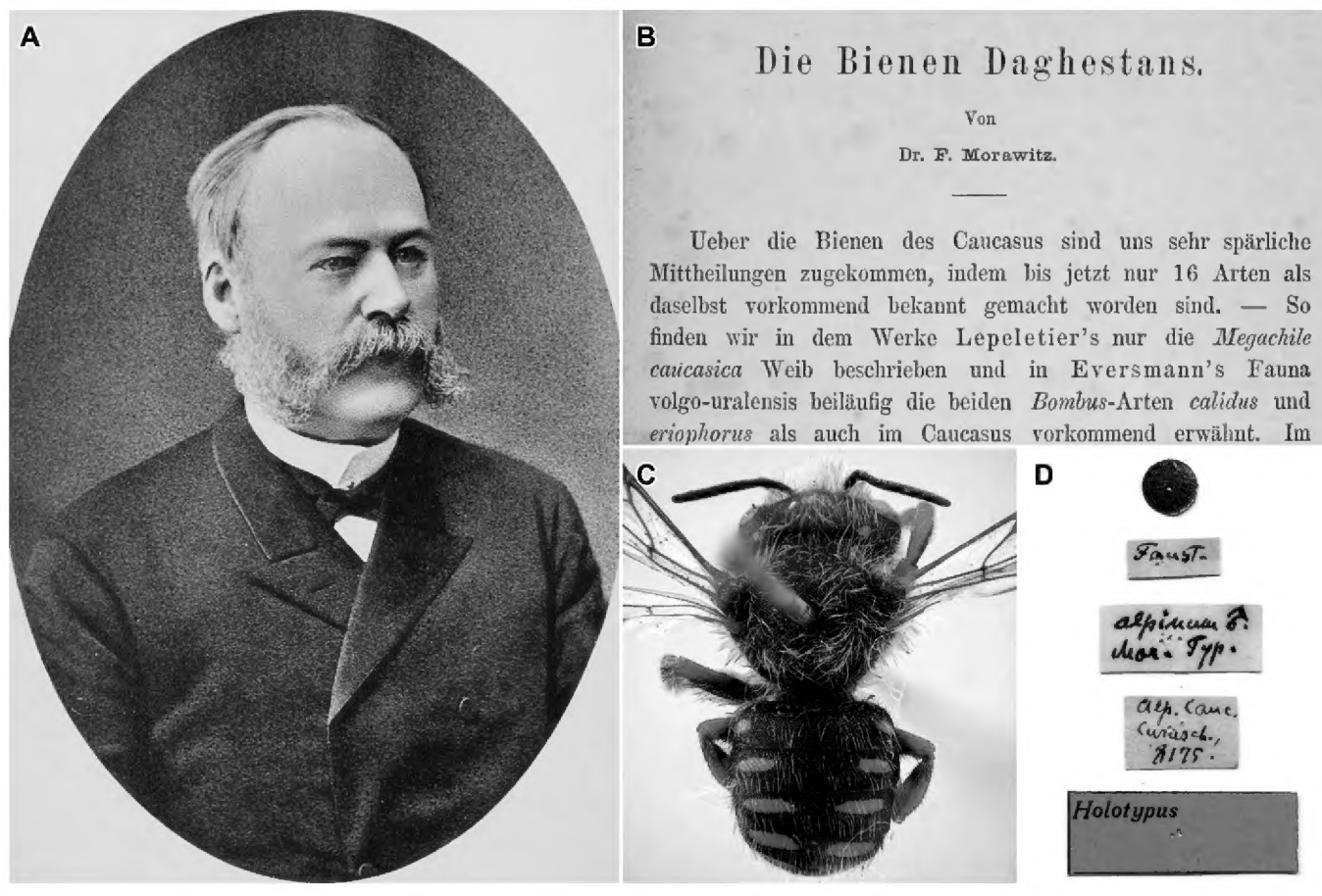

Figure 1. Ferdinand Morawitz and his heritage **A** portrait of F. Morawitz (public domain) **B** beginning of Morawitz's (1873) paper on the bees of Dagestan (public domain) **C, D** male holotype of *Pseudoanthidium alpinum* (Morawitz, 1873) described from Dagestan, dorsal view and labels (photographs by Yu. Astafurova).

Materials and methods

Several field expeditions were made to various districts of the Republic of Dagestan in 2015–2023, where megachilid bees were collected in all types of landscapes and habitats (Figs 2, 3). Collected specimens are deposited mainly in the collections of the Zoological Institute of the Russian Academy of Sciences, Saint Petersburg, Russia [**ZISP**], the Federal Scientific Center of the East Asia Terrestrial Biodiversity of the Far Eastern Branch of the Russian Academy of Sciences, Vladivostok, Russia [**FSCV**], and the research collections of A.V. Fateryga, Feodosiya, Russia [**CAFK**] and T.V. Levchenko, Moscow, Russia [**CTLM**]. Old material deposited in ZISP was also studied. A total of 2,556 specimens of megachilid bees from Dagestan were examined. Selected specimens were sent to be deposited (some of them temporary) in the Entomological Collection of ETH Zurich, Switzerland [**ETHZ**], Muséum d'Histoire Naturelle de Neuchâtel, Switzerland [**MHNN**], and the research collections of M. Kasparek, Heidelberg, Germany [**CMKH**]. Possible literature sources were also studied but the present work is principally based on material directly examined by the authors and does not include data published online that has not otherwise been validated by experts (e.g., observations reported on iNaturalist). The general distributions of species reported as new to Russia are based on Müller (2024) for the tribe Osmiini, as well as Fateryga et al. (2020), Boustani et al. (2021), and Maharramov et al. (2021) for other taxa.

Results

As the result of the study, 2,511 specimens of megachilid bees from Dagestan were identified to 147 species. The remaining 45 specimens represented five species, which identity was unclear. They cannot be identified either without males, as in the case of *Heriades* sp. and *Osmia* (*Pyrosmia*) sp., or in the lack of a comprehensive revision of the corresponding group, as in the case of *Hoplitis* (*Hoplitis*) spp. and *Protosmia* (*Nanosmia*) sp. One more species, *Pseudoanthidium* (*Pseudoanthidium*) *tenellum* (Mocsáry, 1880), was added to the list on the base of a reliable literature record (Litman et al. 2021). A total of 148 species from 16 genera and five tribes were found to occur in Dagestan (Table 2). Full label data of all specimens are represented in Suppl. material 1.

Twelve species are reported here from Russia for the first time; their full label data and general distribution are listed below. Besides them, 55 other species are new to Dagestan and nine of them are also reported for the first time from the North Caucasus as a whole: *Hoplitis* (*Alcidamea*) *praestans* (Morawitz, 1893), *H.* (*A.*) *scita* (Eversmann, 1852), *Osmia* (*Pyrosmia*) *hellados* van der Zanden, 1984, *Stelis* (*Stelidomorpha*) *nasuta* (Latreille, 1809), *S.* (*Stelis*) *odontopyga* Noskiewicz, 1926, *Coelioxys* (*Coelioxys*) *quadridentatus* (Linnaeus, 1758), *C.* (*Paracoelioxys*) *mandibularis* Nylander, 1848, *Megachile* (*Eutricharaea*) *anatolica* Rebmann, 1968, and *M.* (*Megachile*) *lapponica* Thomson, 1872 (Table 2). The record of *Hoplitis scita* is especially remarkable because this species was previously known in Russia only from Siberia and the Far East, while its general distribution includes also Kyrgyzstan, Mongolia, and China (Müller 2024).

Table 2. A list of the megachilid bees of Dagestan (species new to the North Caucasus are indicated with an asterisk; species new to Russia are indicated with two asterisks).

Species name	Literature records	Material examined
Tribe Lithurgini		
Lithurgus chrysurus Fonscolombe, 1834	Fateryga et al. (2019)	43 ♀, 100 ♂
Lithurgus cornutus (Fabricius, 1787)	Morawitz (1873), as *L. monoceros*, partial misidentification of *L. chrysurus*	4 ♀, 1 ♂
Lithurgus tibialis Morawitz, 1875	Fateryga et al. (2019)	2 ♀, 1 ♂
Tribe Osmiini		
Chelostoma (*Chelostoma*) *emarginatum* (Nylander, 1856)**	–	1 ♀, 2 ♂
Chelostoma (*Chelostoma*) *florisomne* (Linnaeus, 1758)	–	2 ♀
Chelostoma (*Foveosmia*) *campanularum* (Kirby, 1802)	Fateryga et al. (2019)	1 ♀, 9 ♂
Chelostoma (*Foveosmia*) *distinctum* (Stöckhert, 1929)	Fateryga et al. (2019)	35 ♀, 24 ♂
Chelostoma (*Foveosmia*) *foveolatum* (Morawitz, 1868)	–	3 ♀, 13 ♂
Chelostoma (*Foveosmia*) *maidli* (Benoist, 1935)**	–	1 ♂
Chelostoma (*Gyrodromella*) *rapunculi* (Lepeletier de Saint-Fargeau, 1841)	–	7 ♀, 34 ♂
Heriades (*Heriades*) *crenulata* Nylander, 1856	–	7 ♀, 38 ♂
Heriades (*Heriades*) *rubicola* Pérez, 1890	–	59 ♀, 19 ♂
Heriades (*Heriades*) *truncorum* (Linnaeus, 1758)	–	8 ♀, 13 ♂
Hoplitis (*Alcidamea*) *acuticornis* (Dufour & Perris, 1840)	–	10 ♀, 1 ♂
Hoplitis (*Alcidamea*) *campanularis* (Morawitz, 1877)**	–	1 ♀, 3 ♂
Hoplitis (*Alcidamea*) *caucasica* (Friese, 1920)**	–	2 ♀
Hoplitis (*Alcidamea*) *curvipes* (Morawitz, 1871)	Fateryga and Proshchalykin (2020); Ivanov et al. (2023)	1 ♀, 5 ♀
Hoplitis (*Alcidamea*) *leucomelana* (Kirby, 1802)	Morawitz (1873), as *Osmia parvula*	26 ♀, 46 ♂
Hoplitis (*Alcidamea*) *ozbeki* Tkalců, 2000	Proshchalykin et al. (2023)	1 ♀, 1 ♂
Hoplitis (*Alcidamea*) *praestans* (Morawitz, 1893)*	–	2 ♀, 4 ♂
Hoplitis (*Alcidamea*) *scita* (Eversmann, 1852)*	–	2 ♀, 5 ♂
Hoplitis (*Alcidamea*) *tridentata* (Dufour & Perris, 1840)	–	16 ♀, 11 ♂
Hoplitis (*Anthocopa*) *caucasicola* Müller, 2012	–	1 ♀
Hoplitis (*Anthocopa*) *jakovlevi* (Radoszkowski, 1874)	Fateryga et al. (2019)	3 ♀, 1 ♂
Hoplitis (*Anthocopa*) *mocsaryi* (Friese, 1895)	Levchenko (2023)	1 ♀, 1 ♂
Hoplitis (*Anthocopa*) *papaveris* (Latreille, 1799)	–	6 ♀, 1 ♂
Hoplitis (*Anthocopa*) *perezi* (Ferton, 1894)**	–	1 ♀, 2 ♂
Hoplitis (*Hoplitis*) *adunca* (Panzer, 1798)	Morawitz (1873), misidentification of *H. manicata*	50 ♀, 43 ♂
Hoplitis (*Hoplitis*) *anthocopoides* (Schenck, 1853)	–	1 ♀, 1 ♂
Hoplitis (*Hoplitis*) *astragali* Fateryga, Müller & Proshchalykin, 2023	Fateryga et al. (2023)	46 ♀, 42 ♂
Hoplitis (*Hoplitis*) *dagestanica* Fateryga, Müller & Proshchalykin, 2023	Fateryga et al. (2023)	6 ♀, 31 ♂
Hoplitis (*Hoplitis*) *linguaria* (Morawitz, 1875)	Proshchalykin et al. (2023)	12 ♀, 4 ♂
Hoplitis (*Hoplitis*) *manicata* Morice, 1901	Fateryga et al. (2019)	11 ♀, 17 ♂
Hoplitis (*Pentadentosmia*) *tringa* (Warncke, 1991)**	–	2 ♀
Osmia (*Allosmia*) *melanura* Morawitz, 1871**	–	10 ♀, 2 ♂
Osmia (*Allosmia*) *rufohirta* Latreille, 1811	–	55 ♀, 5 ♂
Osmia (*Erythrosmia*) *andrenoides* Spinola, 1808	Fateryga (2017)	12 ♀, 5 ♂
Osmia (*Helicosmia*) *aurulenta* (Panzer, 1799)	–	7 ♀, 2 ♂
Osmia (*Helicosmia*) *breviata* Warncke, 1988**	–	1 ♀
Osmia (*Helicosmia*) *caerulescens* (Linnaeus, 1758)	–	29 ♀, 5 ♂
Osmia (*Helicosmia*) *cinerea* Warncke, 1988	Fateryga and Proshchalykin (2020)	3 ♀
Osmia (*Helicosmia*) *dimidiata* Morawitz, 1870	–	2 ♀, 5 ♂
Osmia (*Helicosmia*) *leaiana* (Kirby, 1802)	–	2 ♀
Osmia (*Helicosmia*) *melanogaster* Spinola, 1808	Morawitz (1873), as *O. aterrima*	20 ♀, 9 ♂
Osmia (*Helicosmia*) *niveata* (Fabricius, 1804)	Morawitz (1873), as *O. fulviventris*, misidentification of *O. melanogaster*	26 ♀, 2 ♂
Osmia (*Helicosmia*) *signata* Erichson, 1835	Morawitz (1873), as *O. melanogastra*	9 ♀, 8 ♂
Osmia (*Hoplosmia*) *bidentata* Morawitz, 1875	Fateryga et al. (2019)	5 ♀, 10 ♂
Osmia (*Hoplosmia*) *ligurica* Morawitz, 1868	Fateryga and Proshchalykin (2020)	1 ♀
Osmia (*Hoplosmia*) *scutellaris* Morawitz, 1868	Morawitz (1873)	3 ♀, 1 ♂
Osmia (*Hoplosmia*) *spinulosa* (Kirby, 1802)	Morawitz (1873)	1 ♀, 2 ♂
Osmia (*Metallinella*) *brevicornis* (Fabricius, 1798)	Morawitz (1873), as *O. panzeri*	27 ♀, 9 ♂

Species name	Literature records	Material examined
Osmia (*Osmia*) *apicata* Smith, 1853	Fateryga and Proshchalykin (2020)	8 ♀, 5 ♂
Osmia (*Osmia*) *bicornis* (Linnaeus, 1758)	Morawitz (1873)	12 ♀
Osmia (*Osmia*) *cornuta* (Latreille, 1805)	–	1 ♀, 2 ♂
Osmia (*Osmia*) *mustelina* Gerstäcker, 1869	Fateryga and Proshchalykin (2020)	2 ♀
Osmia (*Osmia*) *scheherazade* Peters, 1978**	–	1 ♀
Osmia (*Pyrosmia*) *cephalotes* Morawitz, 1870	–	35 ♀, 12 ♂
Osmia (*Pyrosmia*) *cyanoxantha* Pérez, 1879	Fateryga and Proshchalykin (2020)	1 ♀
Osmia (*Pyrosmia*) *hellados* van der Zanden, 1984*	–	4 ♀, 4 ♂
Osmia (*Pyrosmia*) *nana* Morawitz, 1873	Morawitz (1873)	1 ♂
Osmia (*Pyrosmia*) *saxicola* Ducke, 1899**		1 ♀
Osmia (*Pyrosmia*) *versicolor* Latreille, 1811	Fateryga and Proshchalykin (2020)	10 ♀, 6 ♂
Osmia (*Pyrosmia*) *viridana* Morawitz, 1873	Morawitz (1873)	35 ♀, 3 ♂
Osmia (*Tergosmia*) *tergestensis* Ducke, 1897	–	6 ♀, 9 ♂
Protosmia (*Protosmia*) *glutinosa* (Giraud, 1871)	Fateryga and Proshchalykin (2020)	4 ♀
Protosmia (*Protosmia*) *tiflensis* (Morawitz, 1876)	Fateryga and Proshchalykin (2020)	7 ♀
Tribe Anthidiini		
Anthidiellum (*Anthidiellum*) *strigatum* (Panzer, 1805)	Morawitz (1873)	20 ♀, 32 ♂
Anthidiellum (*Anthidiellum*) *troodicum* Mavromoustakis, 1949	Proshchalykin et al. (2023)	1 ♀, 1 ♂
Anthidium (*Anthidium*) *cingulatum* Latreille, 1809	Fateryga et al. (2019)	11 ♀, 25 ♂
Anthidium (*Anthidium*) *dalmaticum* Mocsáry, 1884	Proshchalykin et al. (2023)	2 ♀, 7 ♂
Anthidium (*Anthidium*) *diadema* Latreille, 1809	–	1 ♀
Anthidium (*Anthidium*) *florentinum* (Fabricius, 1775)	–	48 ♀, 48 ♂
Anthidium (*Anthidium*) *loti* Perris, 1852	Fateryga et al. (2019)	7 ♀, 11 ♂
Anthidium (*Anthidium*) *manicatum* (Linnaeus, 1758)	–	5 ♀, 2 ♂
Anthidium (*Anthidium*) *melanopygum* Friese, 1917	Fateryga et al. (2019), as *A. spiniventre*; Kasparek and Fateryga (2023)	6 ♀, 11 ♂
Anthidium (*Anthidium*) *punctatum* Latreille, 1809	Fateryga (2017)	10 ♀, 21 ♂
Anthidium (*Anthidium*) *taeniatum* Latreille, 1809**	–	1 ♀, 2 ♂
Anthidium (*Proanthidium*) *oblongatum* (Illiger, 1806)	–	11 ♀, 7 ♂
Eoanthidium (*Eoanthidium*) *clypeare* (Morawitz, 1873)	Morawitz (1873)	1 ♀
Icteranthidium ferrugineum (Fabricius, 1787)	Fateryga et al. (2019)	9 ♀, 9 ♂
Icteranthidium grohmanni (Spinola, 1838)	Fateryga (2017), misidentification of *I. ferrugineum*; Fateryga et al. (2019)	9 ♀, 4 ♂
Pseudoanthidium (*Pseudoanthidium*) *alpinum* (Morawitz, 1873)	Morawitz (1873)	1 ♀, 1 ♂
Pseudoanthidium (*Pseudoanthidium*) *nanum* (Mocsáry, 1880)	Morawitz (1873), as *Anthidium lituratum*; Litman et al. (2021)	6 ♀, 10 ♂
Pseudoanthidium (*Pseudoanthidium*) *stigmaticorne* (Dours, 1873)	Litman et al. (2021)	4 ♀, 4 ♂
Pseudoanthidium (*Pseudoanthidium*) *tenellum* (Mocsáry, 1880)	Litman et al. (2021)	–
Pseudoanthidium (*Royanthidium*) *melanurum* (Klug, 1832)	–	1 ♀, 1 ♂
Pseudoanthidium (*Royanthidium*) *reticulatum* (Mocsáry, 1884)	Fateryga et al. (2019)	2 ♂
Stelis (*Protostelis*) *signata* (Latreille, 1809)	Fateryga (2017)	1 ♀, 3 ♂
Stelis (*Stelidomorpha*) *nasuta* (Latreille, 1809)*	–	3 ♀
Stelis (*Stelis*) *breviuscula* (Nylander, 1848)	–	1 ♂
Stelis (*Stelis*) *odontopyga* Noskiewicz, 1926*	–	1 ♂
Stelis (*Stelis*) *ornatula* (Klug, 1807)	–	5 ♀
Stelis (*Stelis*) *phaeoptera* (Kirby, 1802)	Morawitz (1873); Popov (1933), as *S. phaeoptera meridionalis*	1 ♀, 1 ♂
Stelis (*Stelis*) *punctulatissima* (Kirby, 1802)	–	2 ♂
Stelis (*Stelis*) *scutellaris* Morawitz, 1894	–	1 ♀
Trachusa (*Archianthidium*) *pubescens* (Morawitz, 1872)	Morawitz (1873)	1 ♀, 10 ♂
Trachusa (*Paraanthidium*) *integra* (Eversmann, 1852)	–	2 ♀, 6 ♂
Tribe Dioxyini		
Aglaoapis tridentata (Nylander, 1848)	Fateryga et al. (2019)	4 ♀, 4 ♂
Tribe Megachilini		
Coelioxys (*Allocoelioxys*) *acanthura* (Illiger, 1806)	Fateryga et al. (2019)	3 ♀, 2 ♂
Coelioxys (*Allocoelioxys*) *afer* Lepeletier de Saint-Fargeau, 1841	Morawitz (1873), as *C. coronata*	7 ♀, 16 ♂
Coelioxys (*Allocoelioxys*) *argenteus* Lepeletier de Saint-Fargeau, 1841	Morawitz (1873), as both *C. constricta* and *C. argentea*; Fateryga et al. (2019)	3 ♀, 2 ♂
Coelioxys (*Allocoelioxys*) *brevis* Eversmann, 1852	Morawitz (1873)	6 ♀, 7 ♂
Coelioxys (*Allocoelioxys*) *caudatus* Spinola, 1838	Fateryga et al. (2019)	1 ♀, 2 ♂
Coelioxys (*Allocoelioxys*) *echinatus* Förster, 1853	Fateryga and Proshchalykin (2020)	1 ♂

Species name	Literature records	Material examined
Coelioxys (*Allocoelioxys*) *haemorrhoa* Förster, 1853	Morawitz (1873), as *C. pulchella*	3 ♂
Coelioxys (*Allocoelioxys*) *polycentris* Förster, 1853	Morawitz (1873), as *C. conspersa*; Fateryga et al. (2019)	11 ♀, 5 ♂
Coelioxys (*Coelioxys*) *quadridentatus* (Linnaeus, 1758)*	–	3 ♀, 2 ♂
Coelioxys (*Liothyrapis*) *decipiens* (Spinola, 1838)	Fateryga et al. (2019)	1 ♀, 2 ♂
Coelioxys (*Melissoctonia*) *conoideus* (Illiger, 1806)	Morawitz (1873), as *C. conoidea*	1 ♀
Coelioxys (*Paracoelioxys*) *elongatus* Lepeletier de Saint-Fargeau, 1841	Fateryga and Proshchalykin (2020)	1 ♀
Coelioxys (*Paracoelioxys*) *inermis* (Kirby, 1802)	–	1 ♀, 4 ♂
Coelioxys (*Paracoelioxys*) *mandibularis* Nylander, 1848*	–	3 ♀, 1 ♂
Coelioxys (*Rozeniana*) *aurolimbatus* Förster, 1853	Morawitz (1873), as *C. recurva*	8 ♂
Coelioxys (*Rozeniana*) *rufescens* Lepeletier de Saint-Fargeau & Audinet-Serville, 1825	–	7 ♀, 3 ♂
Megachile (*Chalicodoma*) *albocristata* Smith, 1853	Morawitz (1873), as *Chalicodoma lefebvrei* (misidentified); Fateryga and Proshchalykin (2020)	22 ♀, 8 ♂
Megachile (*Chalicodoma*) *albonotata* Radoszkowski, 1886	Fateryga et al. (2019)	14 ♀, 4 ♂
Megachile (*Chalicodoma*) *alborufa* Friese, 1911	–	6 ♀, 2 ♂
Megachile (*Chalicodoma*) *montenegrensis* Dours, 1873**	–	3 ♂
Megachile (*Chalicodoma*) *parietina* (Geoffroy, 1785)	–	10 ♀
Megachile (*Creightonella*) *albisecta* (Klug, 1817)	–	21 ♀, 23 ♂
Megachile (*Eutricharaea*) *anatolica* Rebmann, 1968*	–	4 ♀, 3 ♂
Megachile (*Eutricharaea*) *apicalis* Spinola, 1808	Morawitz (1873), misidentification of *M. versicolor*	12 ♀, 23 ♂
Megachile (*Eutricharaea*) *argentata* (Fabricius, 1793)	–	55 ♀, 41 ♂
Megachile (*Eutricharaea*) *burdigalensis* Benoist, 1940	Fateryga et al. (2019)	5 ♀, 2 ♂
Megachile (*Eutricharaea*) *deceptoria* Pérez, 1890	Fateryga et al. (2019)	24 ♀, 42 ♂
Megachile (*Eutricharaea*) *giraudi* Gerstäcker, 1869	Fateryga et al. (2019)	11 ♀, 4 ♂
Megachile (*Eutricharaea*) *leachella* Curtis, 1828	Fateryga (2017)	29 ♀, 38 ♂
Megachile (*Eutricharaea*) *leucomalla* Gerstäcker, 1869	Fateryga et al. (2019)	4 ♀
Megachile (*Eutricharaea*) *marginata* Smith, 1853	Fateryga et al. (2019)	11 ♀, 4 ♂
Megachile (*Eutricharaea*) *rotundata* (Fabricius, 1787)	–	19 ♀, 13 ♂
Megachile (*Eutricharaea*) *rubrimana* Morawitz, 1893	Fateryga and Proshchalykin (2020)	1 ♀, 1 ♂
Megachile (*Eutricharaea*) *semicircularis* auct. nec van der Zanden, 1996	Fateryga et al. (2019)	5 ♀
Megachile (*Megachile*) *centuncularis* (Linnaeus, 1758)	–	7 ♀, 10 ♂
Megachile (*Megachile*) *lapponica* Thomson, 1872*	–	1 ♀
Megachile (*Megachile*) *ligniseca* (Kirby, 1802)	–	1 ♀
Megachile (*Megachile*) *melanopyga* Costa, 1863	–	9 ♀, 9 ♂
Megachile (*Megachile*) *octosignata* Nylander, 1852	Fateryga and Proshchalykin (2020)	5 ♀
Megachile (*Megachile*) *pilicrus* Morawitz, 1877	–	14 ♀, 27 ♂
Megachile (*Megachile*) *versicolor* Smith, 1844	–	3 ♀, 9 ♂
Megachile (*Pseudomegachile*) *ericetorum* Lepeletier de Saint-Fargeau, 1841	–	18 ♀, 7 ♂
Megachile (*Pseudomegachile*) *flavipes* Spinola, 1838	Fateryga et al. (2019)	32 ♀, 11 ♂
Megachile (*Pseudomegachile*) *saussurei* Radoszkowski, 1874	Fateryga et al. (2019)	1 ♂
Megachile (*Pseudomegachile*) *tecta* Radoszkowski, 1888	Morawitz (1873), as *M. derasa* (misidentified); Fateryga et al. (2019)	16 ♀, 7 ♂
Megachile (*Xanthosarus*) *analis* Nylander, 1852	–	1 ♂
Megachile (*Xanthosarus*) *circumcincta* (Kirby, 1802)	–	7 ♀, 4 ♂
Megachile (*Xanthosarus*) *lagopoda* (Linnaeus, 1761)	–	6 ♀, 11 ♂
Megachile (*Xanthosarus*) *maritima* (Kirby, 1802)	Morawitz (1873), misidentification of *M. lagopoda*	5 ♀, 7 ♂
Megachile (*Xanthosarus*) *willughbiella* (Kirby, 1802)	–	12 ♀, 9 ♂

New species records for Russia

Chelostoma (*Chelostoma*) *emarginatum* (Nylander, 1856)

Material examined. Russia • Dagestan: Vicinity of Tatil, 42°00'01"N, 48°00'17"E, 4.V.2022, 1 ♂, leg. A. Fateryga [CAFK]; • ibid., 8.V.2022, 1 ♂, leg. A. Fateryga [CAFK]; • ibid., 23.V.2022, 1 ♀, leg. M. Proshchalykin [CAFK].

Distribution. Russia (European part: North Caucasus), Western, Southern, and Eastern Europe, Azerbaijan, Turkey, Iraq, Iran, Turkmenistan.

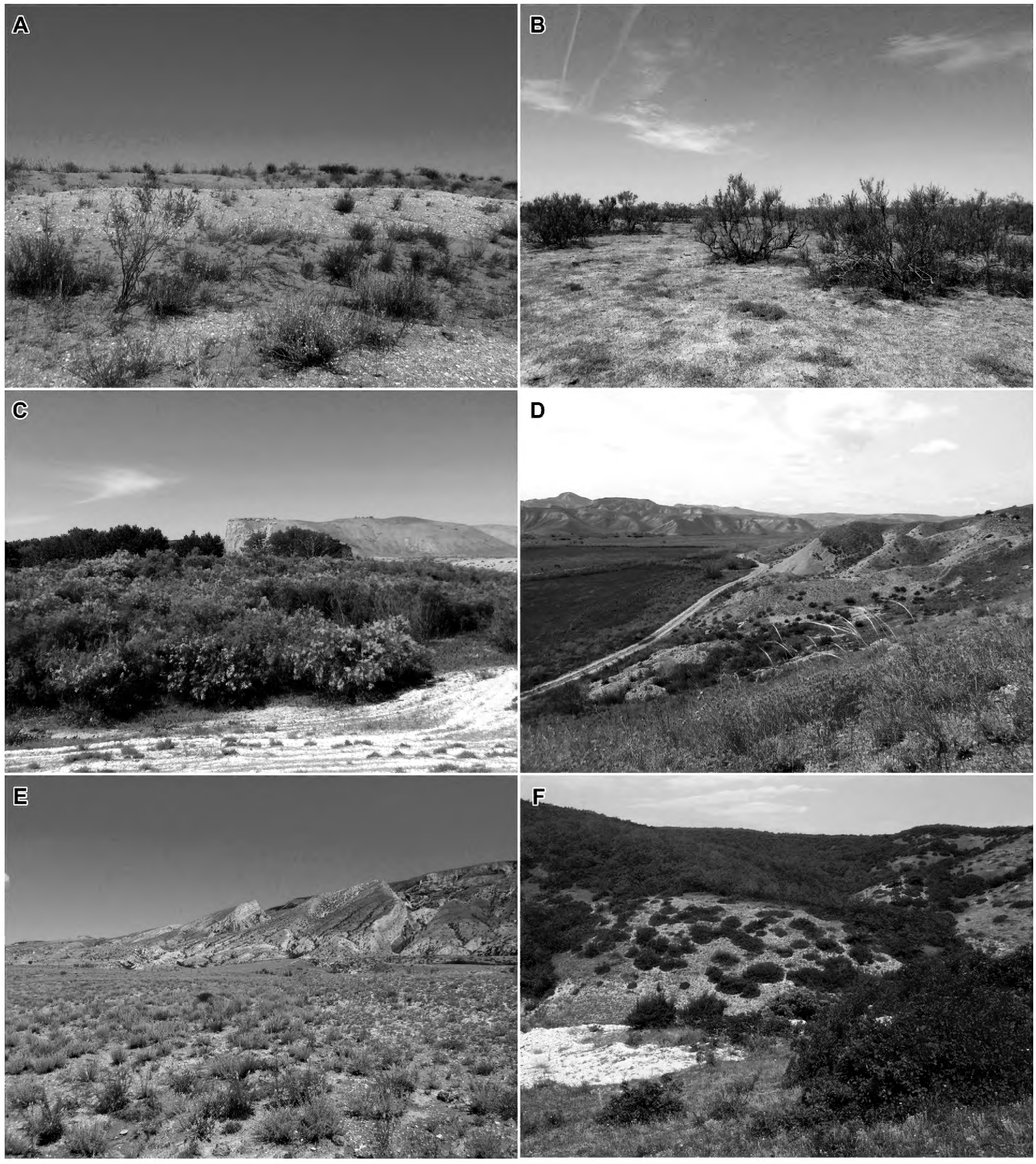

Figure 2. Landscapes of Dagestan **A** coastal dune with flowering *Astragalus hyrcanus* Pall., *A. barbidens* Freyn, and *Gelasia biebersteinii* (Lipsch.) Zaika, Sukhor. & N. Kilian **B** community of *Halostachys caspica* (M. Bieb.) C.A. Mey. in clay desert **C** flowering *Tamarix* spp. in a river valley **D** steppe slope with flowering *Astragalus bungeanus* Boiss. in foothills **E** clay semi-desert with flowering *Reseda globulosa* Fisch. & C.A. Mey. in foothills **F** steppe slope with shrubs at oak forest edge on mountain slope.

***Chelostoma* (*Foveosmia*) *maidli* (Benoist, 1935)**

Material examined. Russia • Dagestan: Tekipirkent, 41°20'18"N, 47°52'32"E, 29.VI.2023, 1 ♂, leg. A. Fateryga [CAFK].

Distribution. Russia (European part: North Caucasus), Turkey, Syria, Lebanon, Israel.

Figure 3. Landscapes of Dagestan **A** limestone scree on mountain slope **B** beech forest on mountain slope **C** limestone mountain slope with flowering *Bilacunaria microcarpos* (M. Bieb.) Pimenov & V.N. Tikhom. **D** sub-alpine meadow with flowering *Coronilla varia* L., *Galium verum* L., *Libanotis pyrenaica* (L.) Bourg., and other herb species **E** alpine shale scree with flowering *Betonica nivea* Steven on mountain slope **F** alpine meadow.

***Hoplitis* (*Alcidamea*) *campanularis* (Morawitz, 1877)**

Material examined. Russia • Dagestan: Vicinity of Talgi, 42°52'36"N, 47°26'42"E, 21.V.2022, 1 ♂, leg. A. Fateryga [CAFK]; • ibid., 21.V.2022, 1 ♀, 1 ♂, leg. D. Puzanov [CAFK]; • Dubki, Sulak River, 43°01'50"N, 46°49'29"E, 31.V.2023, 1 ♂, leg. T. Levchenko [CTLM].

Distribution. Russia (European part: North Caucasus), Southern and Eastern Europe, North Africa, Georgia, Turkey, Lebanon, Israel.

Hoplitis (*Alcidamea*) *caucasica* (Friese, 1920)

Material examined. Russia • Dagestan: Tsudakhar, 42°19'43"N, 47°09'51"E, 15.VI.2023, 2 ♀, leg. M. Proshchalykin [CAFK, ETHZ].

Distribution. Russia (European part: North Caucasus), Azerbaijan, Turkey.

Hoplitis (*Anthocopa*) *perezi* (Ferton, 1894)

Material examined. Russia • Dagestan: 7 km SE Gedzhykh, 42°03'52"N, 48°05'57"E, 3.VI.2019, 1 ♀, 1 ♂, leg. M. Proshchalykin, V. Loktionov [FSCV]; • Derbent, railroad to the north from the fortress wall, on *Convolvulus arvensis*, 4.VII.2022, 1 ♂, leg. T. Levchenko [CTLM].

Distribution. Russia (European part: North Caucasus), Western, Southern, and Eastern Europe, North Africa, Armenia, Azerbaijan, Turkey, Israel, Iran, Afghanistan, Turkmenistan, Tajikistan, Uzbekistan, Kyrgyzstan, Kazakhstan.

Hoplitis (*Pentadentosmia*) *tringa* (Warncke, 1991)

Material examined. Russia • Dagestan: Tsudakhar, 42°19'43"N, 47°09'51"E, 15.VI.2023, 2 ♀, leg. M. Proshchalykin [CAFK, ETHZ].

Distribution. Russia (European part: North Caucasus), Azerbaijan, Turkey, Iran.

Osmia (*Allosmia*) *melanura* Morawitz, 1871

Material examined. Russia • Dagestan: Gelinbatan, 41°56'30"N, 48°10'41"E, 5.V.2022, 8 ♀, 2 ♂, leg. A. Fateryga [CAFK]; • ibid., on *Onobrychis majorovii*, 5.V.2022, 1 ♀, leg. A. Fateryga [CAFK]; • Kamyshchay River valley, 41°54'33"N, 48°13'47"E, on *Astragalus bungeanus*, 5.V.2022, 1 ♀, leg. A. Fateryga [CAFK].

Distribution. Russia (European part: North Caucasus), Southern and Eastern Europe, Armenia, Azerbaijan, Turkey.

Osmia (*Helicosmia*) *breviata* Warncke, 1988

Material examined. Russia • Dagestan: Khotoch, 42°24'52"N, 46°57'10"E, 17.VI.2023, 1 ♀, leg. M. Proshchalykin [ETHZ].

Distribution. Russia (European part: North Caucasus), Southern Europe, Turkey, Lebanon, Israel, Iran.

***Osmia* (*Osmia*) *scheherazade* Peters, 1978**

Material examined. Russia • Dagestan: 5 km NNW Chirag, 41°52'47"N, 47°23'25"E, 25.VI.2023, 1 ♀, leg. M. Proshchalykin [CAFK].

Distribution. Russia (European part: North Caucasus), Turkey, Iran.

***Osmia* (*Pyrosmia*) *saxicola* Ducke, 1899**

Material examined. Russia • Dagestan: Tsudakhar, 42°19'43"N, 47°09'51"E, 28–29.V.2022, 1 ♀, leg. M. Proshchalykin [CAFK].

Distribution. Russia (European part: North Caucasus), Southern and Eastern Europe, Turkey, Cyprus, Syria, Jordan, Lebanon, Israel, Iraq, Iran, Tajikistan.

***Anthidium* (*Anthidium*) *taeniatum* Latreille, 1809**

Material examined. Russia • Dagestan: Belidzhi, hot spring, 41°54'2"N, 48°26'14"E, on *Lotus corniculatus*, 10.VI.2023, 1 ♀, 2 ♂, leg. T. Levchenko [CTLM].

Distribution. Russia (European part: North Caucasus), Western, Southern, and Eastern Europe, Azerbaijan, Turkey, Lebanon, Israel, Iran, Turkmenistan.

***Megachile* (*Chalicodoma*) *montenegrensis* Dours, 1873**

Material examined. Russia • Dagestan: Vicinity of Gubden, 42°34'23"N, 47°33'01"E, 2.VI.2022, 1 ♂, leg. A. Fateryga [MHNN]; • ibid., 3.VI.2022, 2 ♂, leg. A. Fateryga [CAFK].

Distribution. Russia (European part: North Caucasus), Southern and Eastern Europe, North Africa, Armenia, Azerbaijan, Turkey, Syria, Lebanon, Israel, Iran, Afghanistan, Tajikistan, Uzbekistan.

Discussion

The first paper on the bees of the Republic of Dagestan was published 150 years ago by Morawitz (1873) and it contained 30 species of the family Megachilidae, including a species later synonymized (*Coelioxys constrictus* Förster, 1853 with *C. argenteus* Lepeletier de Saint-Fargeau, 1841); some other species were misidentified (Table 2). Recently published papers (Fateryga 2017; Fateryga et al. 2019, 2023; Fateryga and Proshchalykin 2020; Litman et al. 2021; Levchenko 2023; Proshchalykin et al. 2023) added 52 species, including two species described as new to science (Fateryga et al. 2023). By this way, the total number of species of megachilid bees of Dagestan has increased to 81. The present contribution reports a total of 148 species of megachilid bees known from Dagestan. Compared to the first list published by Morawitz (1873), the number of species known from the republic was increased by five times.

Thirty-two species recorded in Dagestan are widespread in the whole Palaearctic region: *Lithurgus cornutus*, *Chelostoma foveolatum*, *C. rapunculi*, *Heriades truncorum*, *Hoplitis leucomelana*, *H. tridentata*, *Osmia leaiana*,

Anthidiellum strigatum, *Anthidium florentinum*, *A. punctatum*, *Stelis ornatula*, *Coelioxys afer*, *C. brevis*, *C. conoideus*, *C. elongatus*, *C. haemorrhoa*, *C. inermis*, *C. mandibularis*, *C. quadridentatus*, *C. rufescens*, *Megachile analis*, *M. centuncularis*, *M. circumcincta*, *M. ericetorum*, *M. lagopoda*, *M. lapponica*, *M. ligniseca*, *M. maritima*, *M. melanopyga*, *M. rotundata*, *M. versicolor*, and *M. willughbiella*.

Fifteen species are widespread in West Palaearctic: *Lithurgus chrysurus*, *Chelostoma campanularum*, *C. florisomne*, *Heriades crenulata*, *Hoplitis anthocopoides*, *H. curvipes*, *H. manicata*, *Osmia melanura*, *O. tergestensis*, *Pseudoanthidium alpinum*, *Stelis odontopyga*, *Trachusa integra*, *Megachile burdigalensis*, *M. leachella*, and *M. octosignata*.

Fifty species are distributed in Europe to Caucasus and Central Asia: *Lithurgus tibialis*, *Heriades rubicola*, *Hoplitis acuticornis*, *H. adunca*, *H. jakovlevi*, *H. perezi*, *H. praestans*, *H. papaveris*, *Osmia bicornis*, *O. brevicornis*, *O. caerulescens*, *O. cephalotes*, *O. cornuta*, *O. dimidiata*, *O. spinulosa*, *O. viridana*, *Anthidium cingulatum*, *A. diadema*, *A. loti*, *A. manicatum*, *A. oblongatum*, *A. taeniatum*, *Icteranthidium ferrugineum*, *I. grohmanni*, *Pseudoanthidium tenellum*, *Stelis breviuscula*, *S. nasuta*, *S. phaeoptera*, *S. punctulatissima*, *S. scutellaris*, *S. signata*, *Aglaoapis tridentata*, *Coelioxys acanthura*, *C. aurolimbatus*, *C. argenteus*, *C. caudatus*, *C. decipiens*, *Megachile albisecta*, *M. apicalis*, *M. argentata*, *M. deceptoria*, *M. flavipes*, *M. giraudi*, *M. marginata*, *M. montenegrensis*, *M. parietina*, *M. pilicrus*, *M. rubrimana*, *M. saussurei*, and *M. tecta*.

Nearly a third of the megachilid fauna of Dagestan is formed by species with smaller ranges or endemic distributions. Forty species are distributed from Southern Europe to the Caucasus, or from the Mediterranean to the Middle East and the Caucasus (some species also occur in Iran, north-western Turkmenistan Afghanistan, and Pakistan): *Chelostoma distinctum*, *C. emarginatum*, *C. maidli*, *Hoplitis campanularis*, *H. mocsaryi*, *Osmia andrenoides*, *O. apicata*, *O. aurulenta*, *O. bidentata*, *O. breviata*, *O. cyanoxantha*, *O. hellados*, *O. ligurica*, *O. melanogaster*, *O. mustelina*, *O. nana*, *O. niveata*, *O. rufohirta*, *O. saxicola*, *O. scutellaris*, *O. signata*, *O. versicolor*, *Protosmia glutinosa*, *P. tiflensis*, *Anthidiellum troodicum*, *Anthidium dalmaticum*, *A. melanopygum*, *Eoanthidium clypeare*, *Pseudoanthidium nanum*, *P. melanurum*, *P. reticulatum*, *P. stigmaticorne*, *Trachusa pubescens*, *Coelioxys echinatus*, *C. polycentris*, *Megachile albocristata*, *M. albonotata*, *M. anatolica*, *M. leucomalla*, and *M. semicircularis*. One species has a remarkably disjunctive distribution in the Caucasus and eastern Central Asia to the Far East: *Hoplitis scita*. Ten species are endemic or subendemic to the Caucasus and Turkey (some of them also occur in Iran or north-western Turkmenistan): *Hoplitis astragali*, *H. caucasica*, *H. caucasicola*, *H. dagestanica*, *H. linguaria*, *H. ozbeki*, *H. tringa*, *Osmia cinerea*, *O. scheherazade*, and *Megachile alborufa*; and one of them (*H. dagestanica*) is known only from Dagestan.

Thus, the fauna of Dagestan is very diverse and consists of species with wide Palaearctic or Western Palaearctic ranges, as well as elements of Mediterranean, European, Central Asian faunas and a relatively small number of endemic species.

According to the studied material, *Lithurgus chrysurus*, *Anthidium florentinum*, *Megachile argentata*, *Hoplitis adunca*, *H. astragali*, *Heriades rubicola*, *Hoplitis leucomelana*, *Megachile leachella*, *M. deceptoria*, and *Osmia rufohirta* are the most common species of megachilid bees in Dagestan, with ≥ 60 collected specimens. At the same time, 20 species are known by one specimen each (Table 2). Only 39 species of megachilid bees were recorded in the northern

half of Dagestan (a part of the Caspian Depression) and just three of them (*Pseudoanthidium tenellum*, *Coelioxys decipiens*, and *Megachile saussurei*) were recorded only there. In the southern half of the republic (a part of the Greater Caucasus), 145 species were recorded. Among the four major landscape zones of this territory, the richest megachilid-bee fauna was revealed in the belt of foothills (109 species). The belt of so-called Intramountain Dagestan numbered 70 species of megachilid bees, 65 species were revealed in the coastal lowland, and 49 in the high mountain belt.

Twenty-five species of megachilid bees of 148 are kleptoparasitic taxa of the genera *Stelis* Panzer, 1806, *Aglaoapis* Cameron, 1901, and *Coelioxys* Latreille, 1809. The remaining 123 species are nest building. In the curse of our fieldwork in Dagestan, we recorded nests of nine species of megachilid bees. Nests of *Hoplitis adunca*, *Osmia caerulescens*, and *O. dimidiata* were recorded in trap nests made of reed stems. Biology of all three species was well studied previously (summarised by Müller 2024). The nests of *O. caerulescens* were especially numerous. A nest of *Megachile albocristata* was found between stones (Fig. 4A). The nest was subsequently sealed by the female bee with pebbles fastened with leaf pulp (Fig. 4B). A nest of *Megachile flavipes* was found in an abandoned nest hole of *Anthophora* sp. (Hymenoptera, Apidae) on a clay cliff. The nest consisted of two cylindrical mud cells (Fig. 4C). A nest of *Hoplitis mocsaryi* was found in the ground, on horizontal surface. The nest entrance was lined with fragments of petals of *Linum tauricum* Willd. (Fig. 4D, E). This bee species is well known to use flax petals (Ivanov and Filatov 2008; Levchenko 2023). Two nests of *Osmia cornuta* were revealed in abandoned nest cells of *Sceliphron* sp. (Hymenoptera, Sphecidae). This bee species is well known to use various pre-existing cavities for nesting (summarised by Müller 2024). Six nests of *Hoplitis astragali* were revealed on a clay cliff (Fig. 4G); females of this species excavated burrows by themselves and used mud for nest construction. The nests were described in detail by Fateryga et al. (2023). The most remarkable nest found in Dagestan was that of *Hoplitis curvipes*. It consisted of two cells placed side by side under a stone; the cells were constructed from leaf fragments, which were imbricately arranged, forming a cone-like structure; each leaf fragment consisted of a basal part that was masticated to leaf pulp and an apical part that protruded freely from the cell wall (Fig. 4H). The nest of this species was described in detail by Ivanov et al. (2023). Males of *Hoplitis curvipes* were recorded sleeping in inflorescences of *Allium rotundum* L. s. l. (Fig. 4I).

The megachilid-bee fauna of Dagestan is rich. Almost 2/3 of all species known from Russia (232 according to Proshchalykin et al. 2023 and present data) occur in Dagestan, while the area of Dagestan is about 0.3% of the area of Russia. The megachilid-bee fauna of Dagestan is less diverse but still comparable to that of neighbouring Azerbaijan, which has 175 species of megachilid bees (Maharramov et al. 2023; Fateryga et al. 2023), while the area of Azerbaijan is more than one and a half times more than that of Dagestan. A comparison of the list of megachilid bees of Azerbaijan (compiled from Fateryga et al. 2020; Proshchalykin and Maharramov 2020; Maharramov et al. 2021, 2023; Fateryga et al. 2023) with that of Dagestan revealed that 109 species (51%) occur in both territories. Our results also show that the knowledge of the family Megachilidae of Dagestan is still incomplete. Despite the reached progress,

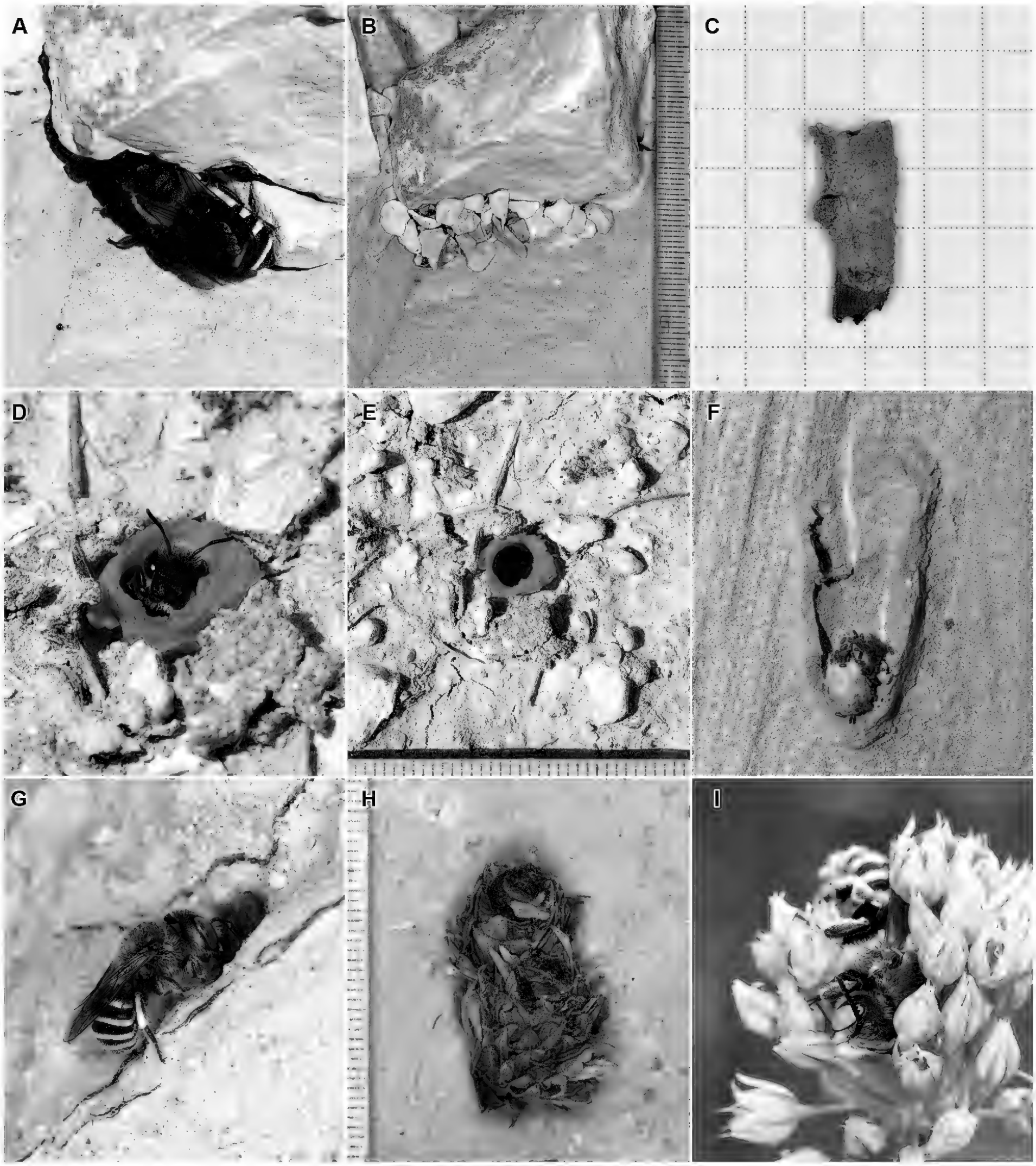

Figure 4. Biology of megachilid bees from Dagestan **A** female of *Megachile albocristata* Smith, 1853 at her nest entrance **B** same nest sealed with pebbles **C** nest cell of *Megachile flavipes* Spinola, 1838 extracted from the substrate **D** female of *Hoplitis mocsaryi* (Friese, 1895) at her nest entrance **E** same nest entrance from above **F** dissected old nest cell of *Sceliphron* sp. with a cell of *Osmia cornuta* (Latreille, 1805) containing a cocoon **G** female of *Hoplitis astragali* Fateryga, Müller & Proshchalykin, 2023 closing her nest with a plug of mud **H** nest of *Hoplitis curvipes* (Morawitz, 1871) extracted from the substrate **I** male of *H. curvipes* sleeping in an inflorescence of *Allium rotundum* L. s. l.

several species remained unidentified, and this problem may be solved only in the curse of special taxonomic investigations of particular subgenera and groups of species. Biology of many species occurring in Dagestan is unknown and should be also studied during further research.

Acknowledgements

We thank Ramazan Murtazaliev and Maxim Mallaliev (Makhachkala, Russia) for their kind help during our research trips to Dagestan. We also thank Yulia Astafurova (Saint Petersburg, Russia) for her help during our work in ZISP. We are also indebted to Timofey Levchenko (Moscow, Russia) for making the material collected by him in Dagestan available to our study. We are especially grateful to Andreas Müller (Zurich, Switzerland) for his kind help in the identification of the bees of the tribe Osmiini. Max Kasparek (Heidelberg, Germany), Yulia Astafurova, and an anonymous reviewer provided helpful suggestions to improve the manuscript.

Additional information

Conflict of interest

The authors have declared that no competing interests exist.

Ethical statement

No ethical statement was reported.

Funding

The research was carried out within the state assignments of the Ministry of Science and Higher Education of the Russian Federation, No. 124030100098-0 (for A.F.) and No. 124012400285-7 (for M.P.).

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Data availability

All of the data that support the findings of this study are available in the main text or Supplementary Information.

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Supplementary material 1

List of specimens examined

Authors: Maxim Yu. Proshchalykin, Alexander V. Fateryga

Data type: xls

Explanation note: List of all 2556 examined specimens of the megachilid bees from Dagestan.

Link: https://doi.org/10.3897/zookeys.1217.134704.suppl1